

# Hospital Admissions Related to Mental Disorders in U.S. Army Soldiers in Iraq and Afghanistan

Barbara E. Wojcik, PhD\*; Fatema Z. Akhtar, MSt†; L. Harrison Hassell, MD\*

**ABSTRACT** We conducted a retrospective study of 473,964 U.S. Army soldiers deployed to Iraq and Afghanistan through December 2004 using deployment and admission records. We categorized mental disorder diagnoses using the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) and identified attempted suicide/self-inflicted injuries using ICD-9-CM diagnosis codes E950–E959. We estimated and evaluated relative risks (RR) using Poisson regression models. Analysis found 1,948 psychiatric hospitalizations of deployed soldiers. The most common mental problems were mood, adjustment, and anxiety disorders (including post-traumatic stress disorder [PTSD]). RR of mental disorders ranged from 1.6 to 3 for females and 2 to 6 for enlisted soldiers compared to their counterparts. Younger soldiers had 30–60% higher substance abuse disorders. Combat units in Iraq demonstrated higher risk of any mental disorder and anxiety problems compared to combat support units. Younger women had the highest incidence of attempted suicide/self-inflicted injuries. Further mental disorders surveillance is recommended.

## INTRODUCTION

U.S. Army soldiers serving in Iraq and Afghanistan are exposed to demanding and stressful conditions on a daily basis, and comprehensive evaluation of their mental health status is needed for military medical planning, preventing, and minimizing potential risk factors. This is especially important because of the unprecedented nature of the current operations. Although analysis of mental health in returnees of the current operations and even of soldiers of past wars has been used inferentially as a surrogate for the mental status of deployed soldiers, mental health data of soldiers while deployed is the best measure of their mental disorder conditions.

The mental health of U.S. soldiers is of interest during both military conflicts and peace. The Millennium Cohort Study<sup>1</sup> of 77,047 U.S. service members in 2001–2003 reported that the baseline mental and physical health for service members was better than the general population; being male, married, better educated, of higher military rank, and being part of the Air Force contributed to better overall health. Attrition and mental health associations have been the focus of several studies. In a comprehensive study, Hoge et al.<sup>2</sup> examined the burden of mental disorders on the utilization of health care and early military attrition among U.S. military personnel across all 4 services from 1990 to 1999. They found the rates of hospitalization for any mental disorder, principal diagnosis of a mental disorder, and substance abuse to be 11.9, 9.8, and 1.9

admissions per 1,000 person-years, respectively (Table I). In a more recent publication, Hoge and colleagues<sup>3</sup> identified a mental health disorder as one of the most common reasons for separation, other than voluntary, in the U.S. active duty personnel hospitalized in 1998. In a study of Australian Royal Navy personnel that included those who participated in the Gulf War, Creamer and colleagues<sup>4</sup> found that mental disorders were related to 19% increased risk of separation; anxiety disorders and post-traumatic stress disorder (PTSD) were significant risk factors for attrition.

Milliken et al.<sup>5</sup> compared surveys that were completed immediately upon return from Iraq to surveys completed 3 to 6 months after return. They identified increased percentages of interpersonal conflicts, PTSD, depression, and overall mental health disorders. Adler et al.<sup>6</sup> found increased depression and PTSD with increased length of deployment in male soldiers deployed to the Balkan theater of operations, but reported increased psychological well-being with number of previous deployments. Many recent articles<sup>7–11</sup> have concentrated on PTSD issues among returnees from Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF). These studies<sup>7,8,11</sup> have reported PTSD prevalence ranging from 5 to 13%. In an anonymous survey of U.S. Army soldiers, Hoge et al.<sup>7</sup> found that of those surveyed, 5.0% of the soldiers before deployment to Iraq ( $n = 2,414$ ), 12.9% of Iraq returnees ( $n = 881$ ), and 6.2% of Afghanistan returnees ( $n = 1,956$ ) screened positive for PTSD. In a subsequent population-based study of Army soldiers and Marines, Hoge and colleagues<sup>8</sup> found that 4.7% of Afghanistan returnees ( $n = 16,318$ ) and 9.8% of Iraq returnees ( $n = 222,620$ ) screened positive for PTSD on a postdeployment health assessment form. Erbes et al.<sup>11</sup> found a PTSD level of 12% on the basis of a survey ( $n = 117$ ) of returnees from OEF and OIF. Shen et al.<sup>12</sup> found that PTSD levels increased significantly with location and duration of deployment, increasing 1.1 percentage points for tours beyond 60 days.

\*AMEDDC&S Center for AMEDD Strategic Studies (CASS) ATTN: MCCS-FH, 1608 Stanley Road, Suite 47, Fort Sam Houston, TX 78234-5047.

†TerraHealth, Inc., 5710 W. Hausman Road, Suite 108, San Antonio, TX 78249.

The views expressed in this article are those of the authors and do not reflect official policy of the Department of the Army, the Department of Defense, or the U.S. government.

This manuscript was received for review in April 2008. The revised manuscript was accepted for publication in June 2009.

Report Documentation Page			Form Approved OMB No. 0704-0188		
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>2009</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-2009 to 00-00-2009</b>	
4. TITLE AND SUBTITLE <b>Hospital Admissions Related to Mental Disorders in U.S. Army Soldiers in Iraq and Afghanistan</b>			5a. CONTRACT NUMBER		
			5b. GRANT NUMBER		
			5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S)			5d. PROJECT NUMBER		
			5e. TASK NUMBER		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) , , , ,			8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Public Release</b>	18. NUMBER OF PAGES <b>10</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

**TABLE I.** Mental Health Hospitalization in the Military, A Summary Across Studies<sup>a</sup>

Author, Year, Reference No.	Population	Type of Health Data	Mental Health
Wojcik et al., 2009, Current study	Army personnel (2001–2004: OIF, <i>n</i> = 476,966 OEF, <i>n</i> = 105,450)	Army hospital admissions. Diagnoses based on ICD9-CM codes.	OIF: Any mental disorders were 10.1% of all admissions. Admission rates (admissions per 1,000 soldier-years): Any mental = 6.42 Principal mental = 4.00 PTSD = 0.46 Substance abuse = 0.77 Personality disorders = 0.75 OEF: Any mental disorders were 11.8% of all admissions. Admission rates (admissions per 1,000 soldier-years): Any mental = 6.44 Principal mental = 4.25 PTSD = 0.29 Substance abuse = 0.98
Hoge et al., 2002, 2	Military personnel across 4 services (1990–1999, <i>n</i> = 4,815,864)	Hospital admissions. Diagnoses based on ICD9-CM codes.	Any mental disorders were 13% of all admissions. Admission rates (admissions per 1,000 person-years): Any mental = 11.9 Principal mental = 9.8 Substance Abuse = 1.9
Hoge et al., 2006, 8	Postdeployment mental health of Army and Marines ( <i>n</i> = 303,905), from OEF, OIF, and other locations, who completed a health assessment (PDHA).	PDHA, Health Care data from DMSS based on ICD9-CM codes.) Rates of psychiatric hospitalizations in first year after post-deployment assessment.	Total psychiatric hospitalizations Admission rates (admissions per 1,000 person-years): OIF, rate = 7.3 OEF, rate = 3.4 Distinct individuals hospitalized admission rates (admissions per 1,000 person-years): OIF, rate = 5.9 OEF, rate = 2.9

<sup>a</sup>Studies using same statistics (rates or RR) are reported.

The fifth Mental Health Advisory Team (MHAT V<sup>13</sup>) established by the Office of the U.S. Army Surgeon General, gathered data to assess and make recommendations concerning behavioral health of soldiers deployed to Iraq and Afghanistan. The MHAT V team used soldier well-being surveys (2,295 in OIF: 699 in OEF), focus group interviews, as well as behavioral health, primary care, and ministry surveys. MHAT V found that the 2007 percentage of soldiers in OIF with mental health problems was similar to OIF levels in previous years, but reported worsened behavioral health in OEF 2007 compared to 2005, specifically with respect to depression, generalized anxiety, and acute stress. MHAT V reported higher drug use in 2007 in OEF compared to OIF while suicide rates were elevated relative to historic Army rates, in both theaters.

Army leadership needs more informed assessment of the psychological resilience of soldiers. Disease and nonbattle injury admissions in Iraq and Afghanistan have been investigated,<sup>14,15</sup> but no study provides information on the magnitude of mental disorder hospitalizations among deployed forces in both recent operations. Most studies of mental disorders of soldiers deployed to Iraq and Afghanistan have been based on surveys administered to nonrandom samples of participants. In contrast, our study examined the entire population of soldiers deployed to OIF and OEF through December 2004. It, therefore, provides additional and in depth analyses of the mental health status of deployed troops. To have a broader understanding of mental disorder problems in theater, our study also included admissions related to attempted suicide and self-inflicted injuries. This study should enhance military medical planning for securing operational effectiveness of deployed soldiers and provide behavioral health professionals insights for developing premobilization intervention and prevention programs.

## METHODS

### Research Design

This retrospective study is composed of all U.S. Army soldiers deployed from September 2001 (OEF) and September 2002 (OIF) through December 2004. The deployed population data were obtained from the Defense Manpower Data Center (DMDC) from the Contingency Tracking System (CTS) file and combined with the inpatient healthcare data from the Patient Administration Systems and Biostatistics Activity (PASBA) Standard Inpatient Data Record (SIDR) database. SIDRs are completed records of patients who have been discharged from the military treatment facilities and include dates of admission and disposition and up to 20 diagnoses per admission. SIDR data includes records of inpatients admitted to Army facilities in theaters of operation as well as to Army facilities in Europe and in the United States. Admissions were summarized as episodes of care, where an episode of care might consist of multiple admissions if the admissions fell within 10 days of each other. This happened when a patient was transferred from one Army facility to another for more definitive care. Mental disorder admission rates were calculated as the total number of episodes of care divided by the total number of soldier-years at risk and multiplied by 1,000.

### Classification of Mental Disorders

The International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes 290–319 cover the broad spectrum of mental disorder conditions. We used these codes from the first 8 SIDR diagnosis fields to identify any mental disorders. The first diagnosis of a SIDR is designated as the principal diagnosis. Similar to Hoge,<sup>2</sup> we further categorized the mental disorders using the Diagnostic and Statistical

Manual of Mental Disorders, 4th edition (DSM-IV) as substance-related, adjustment, mood, personality, psychotic, anxiety, PTSD (a subcategory of anxiety disorder), somatoform/dissociative/factitious, and other mental disorders.

ICD-9-CM codes E950–E959 were used to identify attempted suicide-related/self-inflicted admissions. Because of the small number of attempted suicide-related/self-inflicted admissions, we analyzed hospital admissions (using all 20 diagnoses fields in a record) rather than episodes.

### Statistical Analysis

On the basis of literature review and data availability, several military characteristics and demographic features were considered as potential risk factors for in-theater mental disorder hospitalization. The risk factors included gender (male, female), age at time of deployment (<20 years, 20–29 years, 30–39 years, 40–49 years, 50+ years), race/ethnicity (White, African American, Hispanic, Asian, and Native American), grade (enlisted, officer), component (active duty, guard, reserve), unit (combat support, combat service support, combat), and for OIF only, operation phase,<sup>15</sup> based on deployment dates (phase 1: buildup, September 1, 2002 through March 19, 2003; phase 2: combat, March 20, 2003 through April 30, 2003; and phase 3: stabilization, May 1, 2003 through December 31, 2004). Phase may estimate combat intensity and is based on evolving military planning and goals.

Descriptive analysis of the study population included frequency analysis and percentages by demographic and military characteristics. Days from the beginning of a tour until admission to a treatment facility involving a mental disorder diagnosis were called “days to mental admission.”

Overall admission rates for the 2 operations were calculated. We applied multiple Poisson regression models to estimate relative risk of mental disorders simultaneously adjusting for independent variables. We used GENMOD<sup>16</sup> procedure in SAS 9.1 (SAS Institute Inc., NC). The following benchmark (reference) categories were defined. The relative risk of mental disorders in female soldiers was estimated as compared to male soldiers. Similarly age group younger than 20 years, White race/ethnicity, active duty military component, combat unit, and phase 3 were chosen as reference categories. Levels of a risk factor were compared with the associated reference category by estimated relative risks, 95% confidence intervals (CI), and significance levels (*p*) in models adjusted for gender, age, race/ethnicity, component, grade, unit, and phase categories. To address concerns about the confounding of unit and gender we reanalyzed any mental disorder stratified by gender.

We analyzed the risk of mental disorders (any mental disorder, substance abuse disorder, mood disorder, adjustment disorder, anxiety disorders, and PTSD), adjusted for soldier-years to control for time spent in theater, and controlled for overdispersion by the Pearson scaling factor. We also computed attempted suicide-related hospital admission rates and relative risks by gender and age.

### RESULTS

We examined 473,964 soldiers who contributed to 582,044 combined tours in OIF and OEF; 88,703 (19%) soldiers participated in more than 1 tour. There were 417,412 soldiers deployed to OIF on 476,635 tours; 82,511 (20%) of those soldiers went on multiple tours. In OEF, 92,793 soldiers went on 105,409 tours, and 41,063 (44%) of them served on more than 1 tour. Some differences in demographic composition and military characteristics were observed between deployment locations (Table II). There were 3% more women, 2% more African Americans and Hispanics, and 0.1% more Native Americans in OIF as compared to OEF. The age profile was similar between deployment locations with the vast majority of the soldiers in their twenties and thirties. For military structure, there were 13% fewer combat units, 8% fewer active duty, and 4% fewer officers in OIF.

Ten percent (*n* = 1,948) of the total hospitalizations (episodes of care) in both campaigns included a diagnosis of a mental disorder, and 6% (*n* = 1,225) of the hospitalizations had a principal mental disorder diagnosis. The admission rates for any mental diagnosis were 6.42 admissions per 1,000 soldier-years in OIF and 6.44 per 1,000 soldier-years in OEF. Principal mental disorder hospitalizations rates were 4.00 admissions per 1,000 soldier-years in OIF and 4.25 per 1,000 soldier-years in OEF (Table III).

The 1,225 principal mental diagnoses (Table IV) were composed of 30.8% adjustment disorders, 29.7% mood disorders, 11.7% other mental disorders, 9.7% anxiety disorders (including PTSD; 4.8% of the 1,225 principal diagnoses were PTSD), 6.7% substance abuse disorders, 5.3% psychotic dis-

**TABLE II.** Number (%) of Demographic and Military Characteristics in OIF and OEF

Demographic/Military Characteristics		OIF, number (%)	OEF, number (%)
Gender	Female	46,931 (11)	7,675 (8)
	Male	370,293 (89)	84,812 (92)
Age	<20 years	24,867 (6)	5,299 (6)
	20–29 years	227,600 (55)	49,451 (53)
	30–39 years	113,048 (27)	26,523 (29)
	40–49 years	42,511 (10)	9,455 (10)
	50+ years	9,386 (2)	2,065 (2)
Race/Ethnicity	Asian	11,766 (3)	2,390 (3)
	African American	84,841 (20)	16,710 (18)
	Hispanic	41,051 (10)	7,612 (8)
	White	267,703 (64)	62,965 (68)
	Native American	3,769 (0.9)	728 (0.8)
Component	Unknown	8,282 (2)	2,388 (3)
	Guard	95,582 (23)	18,827 (20)
	Active Duty	256,735 (61)	63,436 (69)
	Reserve	65,095 (16)	10,530 (11)
	Combat Support	110,889 (27)	21,326 (25)
Unit	Combat Service Support	127,463 (31)	17,342 (20)
	Combat	171,818 (42)	47,976 (55)
Grade	Enlisted	362,406 (87)	76,902 (83)
	Officer	54,981 (13)	15,873 (17)

**TABLE III.** Classification of Mental Disorders and Admission Rates per 1,000 Soldier-Years for Mental Disorders in OIF and OEF

Mental Disorder Category	ICD-9 Codes	OIF				OEF			
		Any Mental		Principal		Any Mental		Principal	
		<i>n</i>	Rates	<i>n</i>	Rates	<i>n</i>	Rates	<i>n</i>	Rates
Any Mental	290–319	1,633	6.42	1,017	4.00	315	6.44	208	4.25
Substance-Abuse	291, 303, 305.0, 292 (except 292.2), 304, 305.2–305.7, 305.9	196	0.77	67	0.26	48	0.98	15	0.31
Adjustment	309.0, 309.24, 309.28, 309.3, 309.4, 309.9	397	1.56	306	1.20	89	1.82	71	1.45
Mood	296.2, 296.3, 296.0, 296.4–296.7, 296.80, 296.89, 300.4, 311, 296.90, 301.13	493	1.94	299	1.17	108	2.21	65	1.33
Personality	301.0, 301.2, 301.4, 301.50, 301.6, 301.7, 301.81–301.84, 301.89, 301.9	191	0.75	48	0.19	40	0.82	7	0.14
Psychotic	295.1–295.3, 295.6, 295.7, 295.9, 295.4, 298.8, 298.9, 297.1, 297.3	96	0.38	57	0.22	14	0.29	8	0.16
Anxiety	300.01, 300.21, 300.02, 300.3, 300.22, 300.23, 300.29, 308.3, 309.81, 300.00	260	1.02	110	0.43	40	0.82	9	0.18
PTSD	309.81	116	0.46	53	0.21	14	0.29	6	0.12
Somatoform/ dissociative/ factitious	300.12–300.15, 300.6, 300.16, 300.19, 300.11, 300.7, 300.81, 307.80, 307.89	32	0.13	17	0.07	3	0.06	3	0.06
Other Mental	290.0–290.4, 293 (except 293.1, 293.84), 294, 310.1, 307.1, 307.50, 307.51, 300.9, 316, all 290–319 not listed above	692	2.72	113	0.44	126	2.58	30	0.61

**TABLE IV.** Principal Diagnosis of Admissions With Any Mental Disorders

Principal Diagnosis	OIF		OEF		Total	
	Admissions		Admissions		Admissions	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Mental Disorder	1,017	62.3	208	66.0	1,225	62.9
Disease (Excluding Mental Disorders)	394	24.1	82	26.0	476	24.4
Nonbattle Injury	108	6.6	16	5.1	124	6.4
Battle Injury	114	7.0	9	2.9	123	6.3
Total	1,633	100.0	315	100.0	1,948	100.0

orders, 4.5% personality disorders, and 1.6% somatoform/dissociative/factitious disorders.

#### **Risk Analysis of Mental Disorders—OIF**

One thousand, five hundred sixty-five soldiers had 1,633 hospitalizations in OIF, with a mental disorder diagnosed either as a principal or additional diagnosis. Mental disorders that contributed to the 1,633 hospitalizations were composed of 30% ( $n = 493$ ) mood disorders, 24% ( $n = 397$ ) adjustment disorders, 16% ( $n = 260$ ) anxiety disorders, and 12% ( $n = 196$ ) substance abuse disorders. PTSD constituted 45% ( $n = 116$ ) of the anxiety disorders. Grade, gender, race/ethnicity, age, unit, and phase of operation were identified as statistically significant mental disorder hospitalization risk factors in OIF (Table V).

As compared to male soldiers, female soldiers encountered 60% higher risk of any mental disorder hospitalization, double the risk of mood disorders, 80% higher risk of adjustment disorders, 2.4 times the risk of anxiety disorder admissions, and 3.3 times the risk of PTSD.

Relative to soldiers younger than 20 years, soldiers who were forty years or older experienced 40 to 70% greater risk of

any mental disorder admission. However, the risk of substance abuse was higher in soldiers younger than 20 years old.

African American and Hispanic soldiers had 30% less incidence of any mental disorders and 40% decreased substance abuse and mood disorders as compared to White soldiers. Rates of anxiety disorder and PTSD in African American soldiers were half the rates of White soldiers. Native American soldiers had the most statistically significant increased risk in substance abuse disorder hospitalization, followed by White soldiers.

Risks of any mental disorder, substance abuse, adjustment, and anxiety disorders quadrupled in the enlisted soldiers as compared to officers. Enlisted personnel also suffered 2.5 times greater incidence of mood disorders and 6 times higher risk of PTSD.

Compared to combat units, combat support units had 20 and 40% decreased risks of any mental disorders and anxiety disorders, respectively, but 40% increased risk of mood disorders. The stratified analysis of any mental disorder by gender showed that male soldiers in the combat support unit had statistically significant reduced risk of any mental disorder compared to the combat unit. We did not see the same significant contrast in the female soldiers. Risk of most mental disorders was greater in the earlier operational phases compared to phase 3 (stabilization).

#### **Risk Analysis of Mental Disorders—OEF**

During OEF, 300 soldiers had a total of 315 admissions with any mental disorder. Gender, race, and grade were significant risk factors (Table VI) associated with those hospitalizations.

There were 34% ( $n = 108$ ) mood disorders, 28% ( $n = 89$ ) adjustment disorders, 15% ( $n = 47$ ) substance abuse-related hospitalizations, and 13% ( $n = 40$ ) anxiety disorders. Thirty-

**TABLE V.** Results of Poisson Regression of Mental Disorder Admissions in OIF

OIF	Any Mental Disorder			Substance Abuse Disorder		
	RR	<i>p</i> *	95% CI	RR	<i>p</i>	95% CI
Gender: Female/Male	<b>1.6</b>	<b>&lt;0.0001</b>	<b>1.35–1.91</b>	1.2	0.43	0.77–1.82
Age (years): 20–29/<20	0.9	0.32	0.71–1.12	<b>0.5</b>	<b>0.004</b>	<b>0.36–0.83</b>
30–39/<20	0.9	0.23	0.67–1.10	<b>0.5</b>	<b>0.002</b>	<b>0.29–0.76</b>
40–49/<20	<b>1.4</b>	<b>0.03</b>	<b>1.02–1.80</b>	0.5	0.06	0.3–1.02
50+/<20	<b>1.7</b>	<b>0.02</b>	<b>1.10–2.58</b>	0.5	0.19	0.15–1.47
Race/Ethnic: Asian/White	0.7	0.12	0.48–1.08	1.0	0.98	0.47–2.18
African American/White	<b>0.7</b>	<b>0.0001</b>	<b>0.62–0.86</b>	<b>0.6</b>	<b>0.01</b>	<b>0.41–0.89</b>
Hispanic/White	<b>0.7</b>	<b>0.005</b>	<b>0.59–0.91</b>	0.6	0.06	0.36–1.03
Native American/White	1.5	0.12	0.9–2.35	<b>3.3</b>	<b>0.001</b>	<b>1.59–6.65</b>
Component: Guard/Active Duty	0.9	0.35	0.79–1.09	1.3	0.08	0.97–1.88
Reserve/Active Duty	0.9	0.33	0.76–1.1	0.9	0.50	0.54–1.35
Grade: Enlisted/Officer	<b>4.0</b>	<b>&lt;0.0001</b>	<b>2.94–5.49</b>	<b>3.8</b>	<b>0.0003</b>	<b>1.85–7.9</b>
Unit: Combat Support/Combat	<b>0.8</b>	<b>0.002</b>	<b>0.66–0.91</b>	0.7	0.07	0.51–1.03
Combat Service Support/Combat	1.0	0.90	0.87–1.18	1.0	0.93	0.7–1.38
Operation Phase: Phase I/Phase III	<b>1.2</b>	<b>0.01</b>	<b>1.04–1.43</b>	<b>1.5</b>	<b>0.02</b>	<b>1.05–2.05</b>
Phase II/Phase III	<b>1.4</b>	<b>&lt;0.0001</b>	<b>1.22–1.64</b>	1.4	0.08	0.96–1.92
OIF	Mood Disorder			Adjustment Disorder		
	RR	<i>p</i> *	95% CI	RR	<i>p</i>	95% CI
Gender: Female/Male	<b>2.0</b>	<b>&lt;0.0001</b>	<b>1.55–2.66</b>	<b>1.8</b>	<b>0.003</b>	<b>1.22–2.61</b>
Age (years): 20–29/<20	1.1	0.73	0.71–1.63	0.7	0.14	0.45–1.12
30–39/<20	1.1	0.7	0.7–1.72	<b>0.5</b>	<b>0.02</b>	<b>0.3–0.89</b>
40–49/<20	1.3	0.30	0.78–2.24	0.6	0.13	0.29–1.17
50+/<20	1.9	0.10	0.89–3.93	0.6	0.41	0.15–2.18
Race/Ethnic: Asian/White	0.7	0.39	0.38–1.45	0.7	0.55	0.27–2.02
African American/White	<b>0.6</b>	<b>0.0004</b>	<b>0.45–0.79</b>	1.2	0.43	0.81–1.63
Hispanic/White	<b>0.6</b>	<b>0.02</b>	<b>0.43–0.94</b>	1.1	0.72	0.69–1.72
Native American/White	1.0	0.94	0.41–2.63	1.3	0.67	0.37–4.67
Component: Guard/Active Duty	0.9	0.58	0.69–1.23	0.9	0.48	0.57–1.3
Reserve/Active Duty	0.9	0.5	0.65–1.23	1.2	0.29	0.83–1.89
Grade: Enlisted/Officer	<b>2.5</b>	<b>&lt;0.0001</b>	<b>1.59–3.93</b>	<b>3.6</b>	<b>0.002</b>	<b>1.63–8.18</b>
Unit: Combat Support/Combat	0.9	0.58	0.69–1.23	0.8	0.21	0.53–1.15
Combat Service Support/Combat	<b>1.4</b>	<b>0.03</b>	<b>1.04–1.79</b>	1.0	0.86	0.67–1.39
Operation Phase: Phase I/Phase III	1.3	0.06	0.99–1.69	<b>1.7</b>	<b>0.002</b>	<b>1.22–2.45</b>
Phase II/Phase III	<b>1.5</b>	<b>0.001</b>	<b>1.19–1.96</b>	<b>1.7</b>	<b>0.002</b>	<b>1.22–2.45</b>
OIF	Anxiety Disorder			PTSD		
	RR	<i>p</i>	95% CI	RR	<i>p</i>	95% CI
Gender: Female/Male	<b>2.4</b>	<b>&lt;0.0001</b>	<b>1.62–3.64</b>	<b>3.3</b>	<b>&lt;0.0001</b>	<b>2.05–5.42</b>
Age (years): 20–29/<20	1.1	0.70	0.61–2.1	1.5	0.38	0.62–3.5
30–39/<20	1.3	0.44	0.67–2.54	1.6	0.3	0.65–4.12
40–49/<20	1.6	0.24	0.73–3.51	2.2	0.14	0.77–6.32
50+/<20	2.4	0.13	0.77–7.27	3.5	0.1	0.79–15.21
Race/Ethnic: Asian/White	0.8	0.69	0.33–2.11	1.4	0.50	0.54–3.53
African American/White	<b>0.5</b>	<b>0.003</b>	<b>0.33–0.8</b>	<b>0.5</b>	<b>0.02</b>	<b>0.28–0.88</b>
Hispanic/White	0.9	0.75	0.57–1.5	1.1	0.72	0.62–1.98
Native American/White	1.3	0.67	0.39–4.44	2.2	0.2	0.67–7.27
Component: Guard/Active Duty	0.9	0.66	0.61–1.36	0.9	0.54	0.52–1.41
Reserve/Active Duty	0.7	0.2	0.43–1.19	0.6	0.15	0.31–1.19
Grade: Enlisted/Officer	<b>3.9</b>	<b>0.0005</b>	<b>1.82–8.31</b>	<b>6.2</b>	<b>0.003</b>	<b>1.86–20.49</b>
Unit: Combat Support/Combat	<b>0.6</b>	<b>0.02</b>	<b>0.4–0.93</b>	0.7	0.15	0.42–1.15
Combat Service Support/Combat	0.9	0.74	0.64–1.37	0.7	0.25	0.46–1.22
Operation Phase: Phase I/Phase III	1.1	0.60	0.75–1.65	0.9	0.68	0.52–1.52
Phase II/Phase III	1.2	0.41	0.8–1.74	1.3	0.24	0.83–2.14

\*Values in boldface type imply statistically significant RR at the 0.05 level of significance.

**TABLE VI.** Results of Poisson Regression of Mental Disorder Admissions in OEF

OEF	Any Mental Disorder			Substance Abuse Disorder		
	RR	p*	95% CI	RR	p	95% CI
Gender: Female/Male	<b>2.1</b>	<b>0.002</b>	<b>1.33–3.33</b>	1.4	0.35	0.69–2.83
Age (Years): 20–29/<20	0.8	0.49	0.45–1.47	0.7	0.27	0.31–1.38
30–39/<20	0.7	0.36	0.38–1.41	<b>0.4</b>	<b>0.05</b>	<b>0.18–1.02</b>
40–49/<20	0.9	0.9	0.44–2.05			
50+/<20	1.1	0.84	0.35–3.66			
Race/Ethnic: Asian/White	0.8	0.70	0.3–2.26			
African American/White	<b>0.5</b>	<b>0.01</b>	<b>0.33–0.88</b>			
Hispanic/White	0.7	0.34	0.41–1.37			
Native American/White	1.8	0.38	0.49–6.27			
Component: Guard/Active Duty	1.1	0.53	0.76–1.73	1.4	0.21	0.82–2.41
Reserve/Active Duty	0.9	0.81	0.54–1.63	1.0	0.94	0.41–2.28
Grade: Enlisted/Officer	<b>3.9</b>	<b>&lt;0.0001</b>	<b>2.02–7.39</b>	2.3	0.1	0.89–6.2
Unit: Combat Support/Combat	1.3	0.2	0.87–1.98	0.7	0.35	0.41–1.38
Combat Service Support/Combat	1.4	0.12	0.91–2.3	1.5	0.19	0.82–2.66

  

OEF	Mood Disorder			Adjustment Disorder Disorder		
	RR	p*	95% CI	RR	p	95% CI
Gender: Female/Male	<b>3.1</b>	<b>0.01</b>	<b>1.31–7.5</b>	<b>2.4</b>	<b>0.0005</b>	<b>1.47–4.03</b>
Age (Years): 20–29/<20	0.6	0.39	0.19–1.93			
30–39/<20	0.5	0.26	0.12–1.76			
40–49/<20	0.5	0.37	0.08–2.49			
Race/Ethnic: Asian/White	0.3	0.53	0.01–12.51	1.6	0.26	0.71–3.61
African American/White	0.7	0.52	0.27–1.94	<b>0.4</b>	<b>0.006</b>	<b>0.24–0.79</b>
Hispanic/White	1.1	0.89	0.33–3.62	0.7	0.36	0.36–1.45
Native American/White				<b>4.7</b>	<b>0.0008</b>	<b>1.9–11.5</b>
Component: Guard/Active Duty	1.2	0.77	0.44–3.05	<b>0.6</b>	<b>0.04</b>	<b>0.33–0.98</b>
Reserve/Active Duty	1.1	0.84	0.36–3.49	0.5	0.07	0.23–1.07
Grade: Enlisted/Officer	3.0	0.11	0.78–11.47			
Unit: Combat Support/Combat	1.6	0.36	0.6–4.11	1.1	0.72	0.67–1.81
Combat Service Support/Combat	1.8	0.25	0.65–5.2	<b>1.7</b>	<b>0.03</b>	<b>1.04–2.82</b>

  

OEF	Anxiety Disorder		
	RR	p	95% CI
Gender: Female/Male	<b>3.1</b>	<b>0.008</b>	<b>1.35–7.31</b>
Race/Ethnic: Asian/White	1.9	0.38	0.45–8.07
African American/White	0.9	0.73	0.36–2.05
Hispanic/White	0.9	0.87	0.27–2.99
Component: Guard/Active Duty	1.9	0.08	0.92–4.11
Reserve/Active Duty	1.6	0.35	0.58–4.66
Unit: Combat Support /Combat	0.6	0.30	0.26–1.53
Combat Service Support/Combat	1.1	0.90	0.44–2.57

\*Values in boldface type imply statistically significant RR at the 0.05 level of significance.

five percent of the anxiety disorders were the result of PTSD. Because of small numbers PTSD was not analyzed in OEF. In female soldiers, risks of any mental and adjustment disorders were doubled, and risks of mood and anxiety disorders were tripled as compared to the male soldiers.

Soldiers younger than 20 years old had increased risk of substance abuse hospitalization as compared to all age groups other than 50 years old. Risks of any mental disorder and adjustment disorder admissions were half or less in African American soldiers as compared to White soldiers, but Native American soldiers had 5 times more adjustment problems as compared to White soldiers. National Guards had 40% reduced risk of adjustment disorder admissions as compared to active

duty soldiers. Risk of any mental disorder hospitalization was quadrupled in enlisted soldiers relative to officers. Soldiers in combat service support units were 70% more likely to experience adjustment disorders as compared to combat units.

#### Comparison Between OIF and OEF

Alcohol and drug abuse-related hospitalizations were significantly (30%) lower in Iraq than in Afghanistan (OIF/OEF: RR = 0.71, 95% CI = 0.52–0.97). There were borderline statistical differences at the 0.10 level of significance between Iraq and Afghanistan in adjustment disorder admissions (OIF/OEF: RR = 0.78, 95% CI = 0.60–1.02) and other mental disorder hospitalizations (OIF/OEF: RR = 1.20, 95% CI = 0.98–1.47).

### **Length of Tour and Days to Mental Admissions**

The median time to hospitalization with a mental disorder from the start of a tour was 118 days for soldiers serving in Iraq (mean = 137) and 112 days for those serving in Afghanistan (mean = 135). Seventy percent of admissions in Iraq and 63% of admissions in Afghanistan involving a mental disorder occurred in the latter half of a soldier's tour. Mean length of tour in Afghanistan for soldiers hospitalized with mental disorders was 225 days compared to 169 days for those without mental disorder admissions. In Iraq, the mean length of tour was 210 days for soldiers who had hospitalizations associated with mental disorder, compared to 195 days for soldiers without a mental disorder. This difference was more pronounced during the stabilization phase in OIF, where the mean length of tour was 203 days for soldiers with mental disorder admissions compared to 179 days for soldiers with no mental disorder admissions.

### **Attempted Suicide/Self-Inflicted-Related Admissions**

Both age and gender were strong risk factors in attempted suicide-related admissions for soldiers serving in OIF. Of the 72 attempted suicide-related admissions by male soldiers, those in their twenties had the highest admission rate (20–29 years:  $n = 59$ , rate = 0.46/1,000 soldier-year; 30–39 years:  $n = 8$ , rate = 0.13; 40–49 years:  $n = 4$ , rate = 0.16), whereas the youngest and the oldest age groups had only one or no attempted suicide-related admissions, respectively. There were 49 attempted suicide-related admissions of female soldiers, and the highest admission rates were in female soldiers younger than 30 years old (<20 years:  $n = 8$ , rate = 10.5/1,000 soldier-year; 20–29 years:  $n = 37$ , rate = 2.08).

Similarly, age and gender appear to be risk factors in attempted suicide-related admissions in OEF, although the small sample sizes did not allow decisive conclusions. There were only 6 attempted suicide-related admissions by male soldiers, and 4 of those admissions belonged to male soldiers in their twenties. The 8 female soldiers with attempted suicide-related admissions were all in their twenties.

### **DISCUSSION**

War is an extremely stressful environment that is characterized by constant danger, uncertainty, and confusion. This has prompted us to study, measure, and try to comprehend the resulting mental disorder in soldiers. The present study provides information about the magnitude and characteristics of mental disorder hospitalizations among U.S. Army soldiers deployed in Iraq and Afghanistan through December 2004, as an extension of our ongoing surveillance of U.S. Army hospital admissions in both campaigns.

Similar to previous studies,<sup>3,9</sup> we found that the most common mental problems for deployed soldiers in both Iraq and Afghanistan were mood disorders (including major depression, bipolar disorder, dysthymia), adjustment disorders, anxiety disorders and substance-abuse related disorders. Comparing the operations, we found the incidence rate of substance abuse

to be significantly higher in soldiers deployed to Afghanistan as compared to Iraq.

Admission rates (Table I) reported in a previous study for all 4 branches of military service (Army, Navy, Air Force, Marines) in the 1990s<sup>2</sup> were twice the hospital admission rates for any or principal mental disorders of Army soldiers in this study. However, the percentage of hospital admissions with a mental disorder diagnosis was similar in both studies.

In terms of rates, Hoge et al.<sup>2</sup> found that females, younger age, and single soldiers had higher rates of mental disorder hospitalizations. He also found rates to be similar among African Americans, Hispanics, and Whites, slightly lower for Asian/Pacific Islanders, and higher for American Indian/Alaskan Natives. Rundell<sup>9</sup> studied the demographic characteristics of military personnel who were psychiatrically evacuated from the theater of operations in OEF and OIF. He found that these personnel were more likely to be female, under the age of 31 years, African-American or Hispanic, enlisted, and National Guard/Reserve.

Similar to the above findings, we found that female and enlisted soldiers in Iraq were among the high-risk groups for almost all mental disorders. Similarly, Native American soldiers also demonstrated the highest rate of substance abuse admissions, but for most other mental categories White soldiers were at greater risk, contrary to Hoge. Older soldiers were at higher risk for any mental disorder hospitalization, and younger soldiers were more susceptible to substance abuse disorder. Combat units in Iraq experienced significantly higher risk of any mental disorder and anxiety disorder admissions as compared to combat support units. In terms of overall risk of mental disorder hospitalizations in Iraq, combat service support units demonstrated similar risk as combat units, but they had a 40% higher risk of mood disorder admissions as compared to combat units.

In Afghanistan, female, enlisted, and White soldiers were among the high-risk groups for mental disorder admissions. Younger soldiers were more susceptible to substance abuse disorders. Risk of substance abuse in Afghanistan was also increased in National Guard as compared to active duty soldiers, but the contrast was not statistically significant. Combat service support soldiers had significantly higher risk of adjustment disorder hospitalizations as compared to soldiers in combat units and Native American soldiers also had increased risk of adjustment disorders as compared to White soldiers.

When we searched for the profiles of individuals with the greatest risk of suicide/self-inflicted injury admissions in both OIF and OEF, we found that soldiers in their twenties were most prone to those hospitalizations. Comparison of genders across the same age category suggested that it was the female soldier in her twenties who was the most vulnerable for hospitalizations that include attempted suicide/self-inflicted injury diagnoses. Our findings suggest that female soldiers were at increased risk of all mental disorders including PTSD and attempted suicide/self-inflicted injury disorders.

To summarize, both enlisted soldiers and female soldiers had significantly greater risks for mental disorder hospitaliza-



tions in both operations as compared to their counterparts. Of these high-risk groups, the enlisted soldiers comprised more than 80% of the deployed force. On the other hand, the female soldiers were a minority (OIF, 11%; OEF, 8%). Although age constituted a risk with regard to many mental diagnoses, the specific age category varied with operation and type of mental disorder. Further, small numbers did not always allow meaningful estimation and testing. When it comes to race/ethnicity, White soldiers were at higher risk for most mental disorder hospital admissions in both operations.

Previous studies of subpopulations of soldiers<sup>7,8,11</sup> reported PTSD prevalence ranging from 5 to 13%. After restricting to hospitalizations of Army soldiers with mental health disorders, we found PTSD levels of 4.4% (OEF,  $n = 14$ ) and 7.1% (OIF,  $n = 116$ ). Literature review<sup>10,11,17,18,19</sup> suggests comorbidity of PTSD and substance abuse disorder. We also found higher occurrences of substance abuse disorders in admissions related to PTSD as compared to admissions without PTSD, especially in OEF (28.6% versus 14.6%).

However, these results are not conclusive, as hypothesis testing was not done because of small numbers. In light of current research on the co-occurrence of PTSD and substance abuse, these results reinforce the need to pursue further investigations of PTSD and substance abuse comorbidity.

We observed that most of the mental health admissions occurred in the latter part of a tour. It could be argued that the incidence of mental disorders shortened the tour, with the expected result that most mental admissions would happen at the end of the tour rather than at the beginning. But comparison of tour lengths of soldiers with and without mental disorder-related admissions showed that tour length was longer for those with mental disorders as compared to those who did not have mental disorder-related hospitalizations. This suggests that there may be an association between longer tour lengths and mental disorder health.

Reeve's study<sup>10</sup> brings new clinical awareness to the war-related mental health issues in today's veterans. He classifies mental health into 3 phases: immediate, delayed, and chronic. The immediate response occurs right after the trauma, the delayed response occurs in the aftermath of the battle, and the chronic response occurs months and years after the trauma. Our mental health study falls into the immediate and the delayed categories; therefore, longitudinal studies that include convalescent and rehabilitative care are essential for evaluating the long-term status and impact of mental disorders of soldiers being redeployed to OEF and OIF. Study of return-to-duty status in addition to the length of deployment may provide additional insight into the mental health of deployed soldiers.

The size of the population and the number of medical records lend strength to the current study. By analyzing the number of individual soldiers and number of mental health admissions, we identified specific demographic and force composition criteria that presented an increased risk of mental health admissions. The limitations of this study include lack of predeployment mental health data and exposure to trauma

and other stress-related factors, such as sleep deprivation. As compared to previous wars such as World War II and the Vietnam War, the more recent operations, OIF and OEF, are not major combat operations. Because of limited data we used operational phase as a proxy for intensity of operation, and because the conflicts in Iraq and Afghanistan are not linear tactics,<sup>20</sup> unit types may not represent combat exposure. In the future more definitive markers for exposure and combat intensity may be developed.

This study covered mental disorder episodes of care between September 2001 and December 2004. The increasingly complex military activity in both campaigns as they progress may have growing impact on soldiers' mental health. Therefore, there is a need to evaluate the ongoing trend in mental disorder-related hospitalizations as both campaigns unfold.

## ACKNOWLEDGMENT

The authors acknowledge Toby Dunn, MS, statistician (health), of the Center for Army Medical Department Strategic Studies, for his assistance with data extraction and compilation. They also thank CASS statisticians Rebecca Humphrey, MS and Catherine Stein, MS, for reviewing the manuscript.

## REFERENCES

1. Smith TC, Zamorski M, Smith B, et al: The physical and mental health of a large military cohort: baseline functional health status of the Millennium Cohort. *BMC Public Health* 2007; 7: 340.
2. Hoge CW, Lesikar SE, Guevarra R, et al: Mental disorders among U.S. military personnel in the 1990s: association with high levels of health care utilization and early military attrition. *Am J Psychiatry* 2002; 159: 1576-83.
3. Hoge CW, Toboni HE, Messer SC, Bell N, Amoroso P, Orman DT: The occupational burden of mental disorders in the U.S. military: psychiatric hospitalizations, involuntary separations, and disability. *Am J Psychiatry* 2005; 162: 585-91.
4. Creamer M, Carboon I, Forbes AB, et al: Psychiatric disorder and separation from military service: a 10-year retrospective study. *Am J Psychiatry* 2006; 163: 733-4.
5. Milliken CS, Auchterlonie MS, Hoge CW: Longitudinal assessment of mental health problems among active and reserve component soldiers returning from the Iraq war. *JAMA* 2007; 298: 2141-8.
6. Adler AB, Huffman AH, Bleise PD, Castro CA: The impact of deployment length and experience on the well-being of male and female soldiers. *J Occup Health Psychol* 2005; 10(2): 121-37.
7. Hoge CW, Castro CA, Messer SC, McGurk D, Cotting D, Koffman RL: Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *N Engl J Med* 2004; 351: 13-22.
8. Hoge CW, Auchterlonie JL, Milliken CS: Mental health problems, use of mental health services, and attrition from military service after returning from deployment to Iraq or Afghanistan. *JAMA* 2006; 295: 1023-32.
9. Rundell JR: Demographics of and diagnoses in Operation Enduring Freedom and Operation Iraqi Freedom personnel who were psychiatrically evacuated from the theater of operations. *Gen Hosp Psychiatry* 2006; 28: 352-6.
10. Reeves RR, Parker JD, Konkle-Parker DJ: War-related mental health of today's veterans: new clinical awareness. *J Psychosoc Nurs Ment Health Serv* 2005; 43(7): 18-28.
11. Erbes C, Westermeyer J, Engdahl B, Johnsen E: Post-traumatic stress disorder and service utilization in a sample of service members from Iraq and Afghanistan. *Mil Med* 2007; 172: 359-63.
12. Shen YC, Arkes J, Pilgrim MJ: The effects of deployment intensity on post-traumatic stress disorder: 2002-2006. *Mil Med* 2009; 174: 217-23.

13. Mental Health Advisory Team (MHAT) V: Operation Iraqi Freedom 06-08; Operation Enduring Freedom 8: Afghanistan. 2008. Available at [http://www.armymedicine.army.mil/reports/mhat/mhat\\_v/MHAT\\_V\\_OIFandOEF-Redacted.pdf](http://www.armymedicine.army.mil/reports/mhat/mhat_v/MHAT_V_OIFandOEF-Redacted.pdf); accessed April 2009.
  14. Wojcik BE, Hassell LH, Humphrey RJ, Davis JM, Oakley CJ, Stein CR: A disease and non-battle injury model based on Persian Gulf War admission rates. *Am J Ind Med* 2004; 45: 549–57.
  15. Wojcik BE, Humphrey RJ, Czejdó B, Hassell LH: US Army disease and nonbattle injury model, refined in Afghanistan and Iraq. *Mil Med* 2008; 173: 825–35.
  16. SAS Software. Cary, NC: SAS Institute; 2002-2003.
  17. Rush B, Urbanoski K, Bassani D, et al: Prevalence of co-occurring substance use and other mental disorders in the Canadian population. *La Revue Canadienne de Psychiatrie* 2008; 53(12): 800–9.
  18. Howard D: Chilcoat, Naomi Breslau: Posttraumatic stress disorder and drug disorders: testing causal pathways. *Arch Gen Psychiatry* 2009; 55: 913–7.
  19. Howard S, Hopwood M: Post-traumatic stress disorder, a brief overview. *Aust Fam Physician* 2003; 32(9): 683–7.
  20. Luttwak E: *Strategy: The Logic of War and Peace*. Cambridge, Massachusetts, The Belknap Press, 2001.
-

Copyright of *Military Medicine* is the property of Association of Military Surgeons of the United States and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.